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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/779,457	02/13/2004	Martin Kammler	YOR920030623US1 (8728-671	8968

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EXAMINER	
NOVACEK, CHRISTY L	
ART UNIT	**PAPER NUMBER**
2822	

DATE MAILED: 12/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/779,457	Applicant(s) KAMMLER ET AL.	
	Examiner Christy L. Novacek	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 October 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-19 and 21-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-19 and 21-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the amendment filed October 5, 2005.

Claim Objections

Claims 6 and 23 are objected to because of the following informalities: Claims 6 and 23 recite the limitations of "1013" and "1016". These limitations should be changed to read "10^{13}" and "10^{16}", respectively.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1, 2, 4-11, 13-19, 21-27 and 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xie (US 5,888,885, previously cited) in view of Kato (US 5,532,184, previously cited) and Gerlach et al. (US 6,900,447).

Regarding claim 1, Xie discloses forming a nucleation site including at least one surface or subsurface defect at a predetermined area of the substrate by implantation with ions and growing a quantum dot on the nucleation site (Fig. 4, 5; col. 2, ln. 40 - col. 3, ln. 25). Xie discloses implanting ions into the substrate, but does not disclose what method is used to do the implantation. Like Xie, Kato discloses implanting ions into a substrate at predetermined areas to form locations at which quantum dots are to be grown. Kato teaches that these ions can be successfully implanted using a focused ion beam device (col. 4, ln. 54-63). Kato teaches that

using a focused ion beam device provides the benefits of maskless implantation and makes the fabrication process much easier because the quantum dots are drawn, patterned or formed directly by ion implantation. In addition, no etching process is required, so quantum dots can be fabricated precisely (Abstract). At the time of the invention, it would have been obvious to one of ordinary skill in the art to implants the ions of Xie using the focused ion beam device disclosed by Kato because Xie does not disclose any particular implantation method and Kato teaches that it is advantageous to form quantum dots using a focused ion beam device because it allows for maskless implantation. Kato does not disclose that an electronic microscope is used to align the ion beam on the substrate. Like Kato, Gerlach discloses a focused ion beam device. Gerlach teaches that during nano-fabrication it is advantageous to use an electronic microscope to accurately align the focused ion beam on the substrate (col. 1, ln. 15-25). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the focused ion beam device taught by Gerlach to perform the ion implantation of Xie because Gerlach teaches that by using an electronic microscope the focused ion beam can be accurately aligned to the substrate.

Regarding claims 2 and 18, Xie discloses forming the quantum dot on the nucleation site by strained layer epitaxy (col. 3, ln. 5-45).

Regarding claims 4 and 21, Xie, in one embodiment, discloses implanting Ge ions, but Xie does not limit the type of ions that can be implanted. Like Xie, Kato discloses implanting ions into a substrate at predetermined areas to form locations at which quantum dots are to be grown. Kato teaches that these ions can successfully be implanted using gallium or silicon ions (col. 4, ln. 59-61; col. 6, ln. 26-30). At the time of the invention, it would have been obvious to

one of ordinary skill in the art to use gallium, silicon or any other nonconductive ions big enough to form defects in the substrate for the implantation disclosed by Xie because Xie does not limit the type of ions that can be implanted and Kato teaches that a variety of ions including gallium and silicon can be successfully used to implant the substrate.

Regarding claims 5, 6, 22 and 23, Xie discloses that if germanium ions are implanted, they are implanted at an energy of 50keV with a dosage of 10^{16} ions/cm^2 (col. 4, ln. 18-21). Xie does not disclose implanting gallium ions. As discussed above in reference to claims 4 and 21, it would have been obvious to one of ordinary skill in the art to use gallium ions to implant the substrate of Xie as taught by Kato. Kato teaches that the gallium ions can be implanted at a beam energy of 10-300keV, a beam current of 3-500pA, and a dosage of 10^{11}-10^{15} ions/cm^2 (col. 6, ln. 45-47). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use routine experimentation to determine an optimal length of exposure time of the implantation process of Xie, depending upon the exact beam energy, current and dosage of ions implanted because such variables of art recognized the importance are subject to routine experimentation and discovery of an optimum value for such variables as obvious. See *In re Aller*, 105 USPQ 233 (CCPA 1955).

Regarding claims 7 and 24, Xie discloses that the nucleation site includes a spot formed on the substrate but does not disclose the diameter of the spot. Like Xie, Kato discloses implanting ions into a substrate at predetermined areas to form locations at which quantum dots are to be grown. Kato teaches that these ions can successfully be implanted using a beam width of 2-50nm wide, with a beam size corresponding to the width of the nucleation site (col. 5, ln. 12-16; col. 6, ln. 45-48). At the time of the invention, it would have been obvious to one of

ordinary skill in the art to form the nucleation site of Xie using the beam size and, hence, the nucleation site diameter size, taught by Kato because Xie does not disclose any particular nucleation site diameter and Kato teaches that a nucleation site of 2-50nm wide can successfully nucleate quantum dot growth.

Regarding claims 8 and 25, Xie discloses annealing the substrate after implantation (col. 2, ln. 49-57).

Regarding claims 9 and 26, Xie discloses that the annealing is performed at a temperature in the range of 500-600°C (col. 2, ln. 55-56).

Regarding claim 10, Xie discloses that the substrate is a silicon substrate (col. 2, ln. 17).

Regarding claim 11, Xie discloses that the step of growing a quantum dot on the nucleation site includes growing a Ge island on the Si substrate by strained layer epitaxy (col. 3, ln. 5-45).

Regarding claims 13 and 29, Xie discloses encapsulating the quantum dot (col. 3, ln. 26-45).

Regarding claims 14 and 30, Xie discloses that the step of encapsulating the quantum dot includes forming an overgrowth layer over the substrate and the quantum dot (col. 3, ln. 26-45).

Regarding claims 15 and 31, Xie discloses pre-patterning the substrate to form at least one pre-patterned area (col. 1, ln. 66 – col. 2, ln. 14).

Regarding claims 16 and 32, Xie discloses that the location of the nucleation site is determined based on the pre-patterned area (col. 1, ln. 66 – col. 2, ln. 14).

Regarding claim 17, Xie discloses forming a nucleation site at predetermined area of a semiconductor device layer by implantation with ions, the nucleation site including at least one

surface or subsurface defect at the predetermined area, and growing a quantum dot on the nucleation site (Fig. 4, 5; col. 2, ln. 40 – col. 3, ln. 25). Xie discloses implanting ions into the substrate, but does not disclose what method is used to do the implantation. Like Xie, Kato discloses implanting ions into a substrate at predetermined areas to form locations at which quantum dots are to be grown. Kato teaches that these ions can be successfully implanted using a focused ion beam device (col. 4, ln. 54-63). Kato teaches that using a focused ion beam device provides the benefits of maskless implantation and makes the fabrication process much easier because the quantum dots are drawn, patterned or formed directly by ion implantation. In addition, no etching process is required, so quantum dots can be fabricated precisely (Abstract). At the time of the invention, it would have been obvious to one of ordinary skill in the art to implants the ions of Xie using the focused ion beam device disclosed by Kato because Xie does not disclose any particular implantation method and Kato teaches that it is advantageous to form quantum dots using a focused ion beam device because it allows for maskless implantation. Kato does not disclose that an electronic microscope is used to align the ion beam on the substrate. Like Kato, Gerlach discloses a focused ion beam device. Gerlach teaches that during nano-fabrication it is advantageous to use an electronic microscope to accurately align the focused ion beam on the substrate (col. 1, ln. 15-25). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the focused ion beam device taught by Gerlach to perform the ion implantation of Xie because Gerlach teaches that by using an electronic microscope the focused ion beam can be accurately aligned to the substrate.

Regarding claim 19, Xie discloses that the semiconductor device layer is part of an optoelectronic device (col. 1, ln. 5-16; col. 3, ln. 46-65).

Regarding claim 27, Xie discloses that the substrate is a Si substrate and the step of growing a quantum dot on the nucleation site includes growing a Ge island on the Si substrate by strained layer epitaxy (col. 3, ln. 5-45).

Claims 12 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xie (US 5,888,885) in view of Kato (US 5,532,184) and Gerlach et al. (US 6,900,447) as applied to claim 1 above, and further in view of Fukushima et al. (US 6,351,007, previously cited).

Regarding claims 12 and 28, Xie discloses forming a Ge island by epitaxial growth at a temperature of 550°C, but Xie does not disclose the Ge precursor gas used, nor the pressure under which the reaction takes place (col. 4, ln. 25-33). Like Xie, Fukushima discloses growing a Ge island by epitaxial growth. Fukushima teaches that the Ge island can be successfully grown by using a precursor of digermane gas at a temperature range of 550-600°C at a pressure of 10^{-6} torr (col. 6, ln. 2-15; col. 6, ln. 50-60; col. 10, ln. 62 – col. 11, ln. 4; col. 18, ln. 17-29). At the time of the invention, it would have been obvious to one of ordinary skill in the art to use the Ge growing conditions taught by Fukushima to grow the Ge island of Xie because Fukushima teaches that by using this Ge growth method, a Ge quantum structure of the desired size can be uniformly formed with high reproducibility (col. 17, ln. 49 – col. 18, ln. 53).

Response to Arguments

Applicant's arguments with respect to claims 1, 2, 4-19 and 21-32 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christy L. Novacek whose telephone number is (571) 272-1839. The examiner can normally be reached on Monday-Thursday and alternate Fridays 7:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

CLN
December 21, 2005

ZANDRA V. SMITH
PRIMARY EXAMINER
Dec. 22, 2005